CLAIMS:

1. A self-assembly process for preparing luminescent organic-inorganic nanocomposite thin films comprising the steps:

obtaining a homogeneous solution in a solvent system of water and an organic solvent, said homogeneous solution comprising:

a soluble silicate;

a silica coupling agent containing a silica reactive moiety and an organic reactive moiety;

a surfactant having a hydrophobic portion and a hydrophilic portion, said surfactant having a concentration below the critical micelle concentration; and

an organic material containing a functional moiety substituent selected from hole transport, electron transport, and emissive material moieties and wherein said organic material is soluble or dispersible in the homogeneous solution;

depositing a film of the homogeneous solution on a substrate; and

preferentially evaporating the organic solvent to enrich the concentration of water and non-volatile homogeneous solution components within the depositing film to promote micelle formation, such that the organic material migrates into a hydrophobic portion of the forming micelles and wherein continued evaporation promotes self-assembly of the micelles into interfacially organized liquid crystalline mesophases.

2. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, further comprising the step of initiating and propagating a reaction between the organic material and the silica coupling agent to form a nanostructure self-assembly.

3. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 2, wherein the reaction between the organic material and the silica coupling agent is a thermal-induced process.

4. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 2, wherein the reaction between the organic material and the silica coupling agent is a photo-induced process.

5. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the formation of self-assembled liquid crystalline mesophases occurs in less than approximately one minute.

6. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the organic solvent is a lower alkyl alcohol, C_1 to C_4.

7. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the organic solvent is a polar aprotic solvent.

8. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 7, wherein the aprotic solvent is selected from tetrahydrofuran (THF), diethylether, dioxane, N,N-dimethylformamide (DMF), N,N-dimethylacetamide (DMAC), N-methylpyrrolidone (NMP), dimethyl sulfoxide (DMSO), and acetone.

9. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the functional moiety substituent contains a reactive functional group selected to react with the silica coupling agent.

10. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 9, wherein the reactive functional group is selected from methacrylate, acrylate, styrenyl, vinyl, alkyl halide, epoxy, and amino.

11. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the coupling agent

12. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, further comprising the step of selectively removing the surfactant by washing.

13. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the soluble silicate is $Si(OR_{4-n})_4$, where R is lower alkyl (C_1-C_4) and n is 0 to 3.

14. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the soluble silicate is tetraethylorthosilicate.

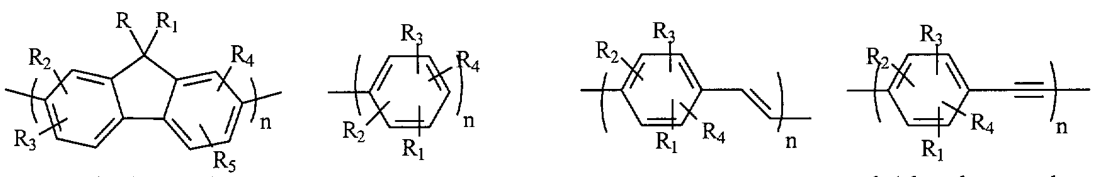
15. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the soluble silicate is treated with catalytic acid or base to initiate a sol-gel process within the deposited thin film.

16. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the surfactant is an amphiphilic surfactant.

17. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the functional moiety is selected from aromatic pyridines, aromatic boranes, quinolines, triazoles, oxadiazoles, dicyanoimidazoles, triazines, and derivatives and combinations thereof.

18. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the hole transport moiety is selected from aromatic phosphines, aromatic amines, thiophenes and polythiophenes, silanes and polysilanes, and derivatives and combinations thereof.

19. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the emissive moiety is selected from the following functional moiety substituent groups:



poly(fluorenes) poly(m- or p-phenylene) poly(phenylenevinylene) poly(phenyleneacetylenes)

Where R_1-R_5 are the same or different selected from H, C, O, N, S, Si, Ge, fluoroalkanes, flourosilylalkanes, solubilizing groups, and reactive functional groups, and n is selected to provide desired emissive properties and ranges from 1 to 100.

20. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the emissive moiety is selected from metal:ligand complexes where the metal is: Al, B, Ir, Pt, Eu, or Tr, and the ligand is quinoline, bipyridine, or pyridine.

21. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the nanostructure self-assembly has a layered structure.

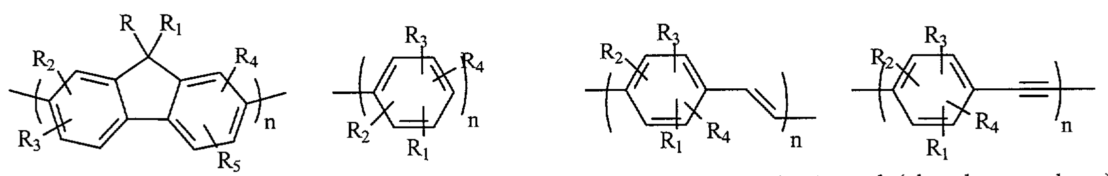
22. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 1, wherein the nanostructure self-assembly has a tubular structure.

23. A luminescent ordered nanocomposite structure comprising a plurality of silica layers, wherein the silica is chemically bound to organic compounds disposed between the silica layers, wherein the organic compounds contain electron transport, hole transport, and/or emissive functional groups.

24. A luminescent ordered nanocomposite structure according to claim 23, wherein electron transport moiety is selected from aromatic pyridines, aromatic boranes, quinolines, triazoles, oxadiazoles, dicyanoimidazoles, triazines, and derivatives and combinations thereof.

25. A luminescent ordered nanocomposite structure according to claim 19, wherein the hole transport moiety is selected from aromatic phosphines, aromatic amines, thiophenes and polythiophenes, silanes and polysilanes, and derivatives and combinations thereof.

26. A luminescent ordered nanocomposite structure according to claim 19, wherein the emissive moiety is selected from the following functional moiety substituent groups:



poly(fluorenes) poly(m- or p-phenylene) poly(phenylenevinylene) poly(phenyleneacetylenes)

Where R_1-R_5 are the same or different selected from H, C, O, N, S, Si, Ge, fluoroalkanes, fluorosilylalkanes, solubilizing groups, and reactive functional groups, and n is selected to provide desired emissive properties and ranges from 1 to 100.

27. A luminescent ordered nanocomposite structure according to claim 19, wherein the emissive moiety is selected from metal:ligand complexes where the metal is: Al, B, Ir, Pt, Eu, or Tr, and the ligand is quinoline, bipyridine, or pyridine.

28. A process for preparing a luminescent organic-inorganic nanocomposite thin film comprising the steps:

admixing a silica sol with a silica coupling agent containing a reactive functional group, a surfactant having a concentration below the critical micelle

concentration, an organic solvent, and an organic material containing a functional moiety substituent selected from hole transport, electron transport, emissive material moieties and precursors thereof;

evaporating the organic solvent to induce micelle formation and form a liquid mesophase material; and

initiating and propagating a reaction between the organic material and the silica coupling agent to form a nanostructure self-assembly.

29. A process for preparing a luminescent organic-inorganic nanocomposite thin film according to claim 28, wherein the silica coupling agent and organic material are combined as a single molecule.

30. An organic-inorganic HLED device comprising:

an anode containing a high work function metal or metal alloy;

a cathode containing a low work function metal or metal alloy; and

a luminescent ordered nanocomposite structure electrically connected to the anode and cathode, said ordered structure comprising a plurality of silica layers, wherein the silica is chemically bound to organic compounds disposed between the silica layers, wherein the organic compounds contain electron transport, hole transport, and/or emissive functional groups.

31. An organic-inorganic HLED device according to claim 30, further comprising a transparent substrate upon which the device is fabricated.

32. An organic-inorganic HLED device according to claim 30, wherein the anode is selected from gold, silver, copper, fluorine-tin oxide (FTO), doped zinc oxide, and indium-tin oxide (ITO).

33. An organic-inorganic HLED device according to claim 30, wherein the anode is selected from poly(aniline) (PANI) and poly(2,3-ethylenedioxy)thiophene (PEDOT).

34. An organic-inorganic HLED device according to claim 30, wherein the cathode is selected from calcium, magnesium, lithium, sodium, aluminum, and alloys thereof.

35. An organic-inorganic HLED device according to claim 30, wherein the cathode is selected from mixtures of calcium, magnesium, lithium, sodium, and aluminum with halogen salts of a group IA metal.

36. A self-assembly process for preparing luminescent organic-inorganic nanocomposite thin films comprising the steps:

obtaining a homogeneous solution in a solvent system of water and an organic solvent, said homogeneous solution comprising:

a soluble silicate;

a silica coupling agent containing a silica reactive moiety and an organic reactive moiety, wherein the organic reactive moiety is a monomer precursor of a hole transport, electron transport, or emissive material; and

a surfactant having a hydrophobic portion and a hydrophilic portion, said surfactant having a concentration below the critical micelle concentration;

depositing a film of the homogeneous solution on a substrate; and

preferentially evaporating the organic solvent to enrich the concentration of water and non-volatile homogeneous solution components within the depositing film to promote micelle formation, such that the organic material migrates into a hydrophobic portion of the forming micelles and wherein continued evaporation promotes self-assembly of the micelles into interfacially organized liquid crystalline mesophases.

37. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 36, further comprising the step of initiating and propagating a

polymerization reaction between the silica coupling agents to form a nanostructure self-assembly.

38. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 37, wherein the polymerization reaction is a thermal-induced process.

39. A process for preparing luminescent organic-inorganic nanocomposite thin films according to claim 37, wherein the polymerization reaction is a photo-induced process.